CORRECTED DIRECT TESTIMONY OF

DAVID G. HILL, PH. D.

ON BEHALF OF

SOUTHERN ALLIANCE FOR CLEAN ENERGY AND

SOUTH CAROLINA COASTAL CONSERVATION LEAGUE

DOCKET NO. 2019-226-E

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I. INTRODUCTION AND SUMMARY

Q: Please state your name and professional title.

A: My name is David Hill and I am a Managing Consultant with Energy Futures Group, Inc. in Hinesburg, Vermont.

Q: On whose behalf are you testifying?

A: I am testifying on behalf of the Southern Alliance for Clean Energy ("SACE") and the South Carolina Coastal Conservation League ("CCL").

Q: Please describe your current role and relevant work experience.

A: I joined Energy Futures Group (EFG) in January of 2020. My work since then has included a critical analysis for the need of a proposed natural gas pipeline expansion in New York City, support for testimony on the partial transfer of ownership of a coal fired power plant in Montana, analysis of the customer economics for strategic electrification in Illinois, scenario modeling for statewide greenhouse gas reduction strategies in Massachusetts, and analysis of cost recovery for utility efficiency and demand response initiatives in Maryland.

EFG is a clean-energy consulting firm headquartered in Hinesburg, Vermont, with offices in Boston and New York. EFG designs, implements, and evaluates programs and policies to promote investments in efficiency, renewable energy, other distributed resources, and strategic electrification. EFG staff have delivered projects on behalf of energy regulators, government agencies, utilities, and advocacy organizations in 40 states, 8 Canadian provinces, and several countries in Europe.

EFG brings to its work a unique combination of technical, economic, program, and policy expertise. EFG staff have critically evaluated hundreds of efficiency and

renewable energy programs, playing key roles in developing many that have subsequently won awards for excellence. Recent work involves efficiency program portfolios and policies in each of the fifteen highest-ranking states on the ACEEE State Energy Efficiency Scorecard, as well as in Ontario, Manitoba and British Columbia. We have also provided expert witness testimony on efficiency programs, integrated resource planning, and related policy issues in regulatory proceedings in twenty states and five Canadian provinces.

Prior to joining EFG, I worked for the Vermont Energy Investment Corporation (VEIC) for twenty-two years, starting in 1998 as an analyst, subsequently holding several positions over the decades, serving my last five years as Director of Distributed Resources and Policy Fellow.

As the Director of Distributed Resources and a Policy Fellow at VEIC, I was responsible for advancing sustainable energy program design and evaluation. For two decades, I regularly led major consulting assignments at VEIC, being best known for my work in distributed energy resources, particularly solar energy. I provided expert testimony and regulatory support on renewable energy and energy efficiency in six jurisdictions in Canada and the United States. I was regularly engaged as an expert on renewable energy market design; and regulatory issues at international, national and regional conferences and workshops. I served on national, state, and local level boards. I also led policy committees and conferences, and comprehensive studies of the economic, technical, and achievable potentials for sustainable energy programming. My work also supported detailed level program budget planning and implementation.

Over the years, I have led or significantly contributed to the design and development of more than six large programs, with annual budgets of $100+ million, for initiatives in New Jersey, New York, Vermont, Arizona, and Maryland. My clients are in more than a dozen states and provinces, and six countries outside North America. I have conducted work for several international organizations, including the World Bank. I have also created and led the launch of Sun Shares, a subsidiary of VEIC that develops and provides community solar services to employers and their employees.

I have provided testimony in regulatory hearings on more than a dozen occasions and have participated in scores of technical workshops and working groups on behalf of many clients. In 2019 I presented at a technical workshop on efficiency portfolio diversification and submitted supporting testimony in Nova Scotia on behalf of EfficiencyOne. In 2018, I provided testimony on behalf of the Ecology Action Centre to the Nova Scotia Utility and Review Board regarding NS Power's Advanced Metering Infrastructure project.[1] For the last decade, I have provided ongoing expert review and testimony on EmPOWER Maryland's energy efficiency portfolio on behalf of that state's Office of People's Counsel. I also led VEIC's team in a review of utility efficiency programs for the Pennsylvania Office of Consumer Advocate on that state's legislatively authorized efficiency initiatives (Act 129), providing testimony in 2013 and 2009. I have also provided expert review and testimony on proposed efficiency programs of Brampton and Hydro One in Ontario, on behalf of the Green Energy Coalition in 2005.

[1] Nova Scotia Utility and Review Board, Matter M08349, Direct Testimony of David G. Hill on Behalf of Ecology Action Centre, January 18, 2018.

In addition, I have written, presented, and / or defended written analyses and / or testimony for regulatory workshops, commission staff, and legislative hearings on efficiency, alternative rate design, net metering and interconnection of distributed energy systems, and strategies for sustainable development of solar markets. This has included my work in New York, Pennsylvania, Vermont, Arizona, Michigan, and New Jersey. Further details on my work experience and education are provided in my professional resume included as **Exhibit DH-1**.

Q: Have you been assisted with the development of this testimony?

A: Yes. My work on this testimony has been significantly supported by Chelsea Hotaling, an EFG analyst and colleague with expertise in Integrated Resource Plan and production cost modeling. **Exhibit DH-2** provides her professional resume. I appreciate and acknowledge her support. I also stand behind all the testimony provided here, and am responsible for the final content, findings, and recommendations.

Q: What is the purpose of your testimony in this proceeding?

A: The purpose of my testimony is to describe the results of my review and analysis of the Dominion Energy South Carolina, Inc. ("DESC" or "Company") 2020 Integrated Resource Plan ("2020 IRP"), which was filed before the Public Service Commission of South Carolina ("Commission") on February 28, 2020. Specifically, I evaluated whether DESC used reasonable assumptions and methodologies in the 2020 IRP, based on my experience working in other jurisdictions, knowledge of industry standards, technological developments, and best available data and information.

The 2020 DESC IRP is the first IRP submitted by any South Carolina utility under the new provisions of the Energy Freedom Act ("EFA"), and this proceeding is

thus an important opportunity for the Commission and the Company to set standards and expectations on energy system planning. It is also an important opportunity to reflect significant changes in energy markets and technologies, including but not limited to lower costs for solar and battery storage and advances in opportunities for customer demand response and energy efficiency.

Q: Please summarize your key findings.

A: Based on my experience working in other jurisdictions, and my review of the DESC 2020 IRP and its supporting materials,[2] I identify several flaws in DESC's analysis, assumptions, and methodologies related to demand-side, solar, and storage resources. In light of these flaws, the 2020 IRP does not "fairly evaluate" these resources contemplated by the EFA. Had DESC fairly evaluated these resources, it is very likely a clean energy portfolio would have emerged as a clear choice for a preferred plan.

Second, I find that DESC did not fully and accurately characterize and include demand-side resources in the 2020 IRP as called for in the EFA.[3] In the IRP, DESC only includes a "high case" for demand-side management ("DSM") resources in a cursory fashion, dismissing it as being likely unachievable and not cost effective. DESC's 2020 IRP also unreasonably understates the value of DSM resources while overstating their costs, which impacts the sufficiency of its analysis across all portfolios and scenarios analyzed. DESC also did not include as part of the portfolios it modeled in the 2020 IRP demand response ("DR") resources that were identified as cost effective in the 2019

[2] These supporting documents include the 2020 IRP, DESC's direct testimony and exhibits in this proceeding, the Charles River Associates review of the 2020 IRP, and DESC's 2019 Market Potential Study, which was conducted by ICF. SACE and CCL also submitted three discovery requests to DESC, the responses to which were also used to support this testimony.
[3] S.C. Code Ann. § 58-37-40.

DESC Market Potential Study.[4] As such, the 2020 IRP unreasonably understates the ability of energy efficiency, demand response, and flexible load options to meet DESC's system needs, and is evidence that DESC did not conduct a fair evaluation of such resources.

Third, I conclude that the cost projections used by DESC for solar and battery technologies in the 2020 IRP are significantly higher than industry references. The use of this skewed data in DESC's portfolios understate the ability of batteries and solar to cost effectively contribute to meeting future system needs.

Lastly, I found that DESC did not compare the Intervenor Provided Resource Plans and Scenarios against its eight resource plans, did not provide justification for why such a comparison was impossible, and did not explain adequately why the intervenor inputs were unreasonable. ***For every scenario, the intervenor's least cost resource plan is less costly than the least cost portfolio in the Company's Plan for the same scenario***. A more complete evaluation of the clean energy resources included in the intervenor plans should be required.

Q: Please summarize your recommendations.

A: I respectfully recommend that the Commission (1) reject the DESC 2020 IRP as filed and (2) order DESC to correct and refile its 2020 IRP to remedy the deficiencies in its analyses of demand-side, solar, storage, gas and coal resources. The Commission order should also require the refiled plan to more meaningfully compare the intervenor-provided resource plans against DESC's eight portfolios.

[4] Dominion Energy South Carolina: 2020–2029 Achievable DSM Potential and PY10–PY14 Program Plan Final Report, ICF International, June 2019.

Q: How is the remainder of your testimony organized?

A: Section II of my testimony briefly reviews the portfolio cost ranking and plan preferences in the DESC 2020 IRP. Even with DESC's use of some questionable assumptions and resource characterizations[5], DESC's 2020 IRP analysis illustrates that portfolios with higher levels of demand side resources, renewable energy, and the early retirement of coal plants have lower or comparable costs to the portfolio the Company identifies as its base portfolio. At the same time, these cleaner portfolios have significantly lower emissions and other risks.

In Section III, I explore DESC's IRP modeling and methods in greater depth, including the load forecast as well as the characterization and modeling of demand-side resources, including energy efficiency, demand response, and flexible load resources, and solar and battery storage resources. I recommend analytical improvements that, if adopted, would yield greater ratepayer benefits by retiring coal plants and implementing higher levels of demand-side resources and renewable energy. I also address DESC's failure to meaningfully assess the Intervenor Provided Resource Plans and Scenarios as required by the settlement with the South Carolina Solar Business Alliance in connection with the Dominion Energy/SCANA merger.

Finally, in Section IV I provide a summary of my findings and my recommendations to the Commission.

[5] In my testimony I use the term "characterization" to refer to the set of engineering, economic, and market assumptions that planners use when defining and assessing resources.

II. REVIEW OF DESC's PORTFOLIO COST COMPARISONS

Q: Please summarize how DESC developed and modeled resource portfolios in the IRP.

A: The IRP identified eight resource portfolios, as shown in the table below.[6]

Table 1. Description of Resource Plans

Resource Plan ID	Resource Plan Name	Resource Plan Description
RP1	CC	Combined Cycle, ICTs
RP2	ICT	ICTs
RP3	Retire Wateree	Wateree 1 & 2 retirement, Combined Cycle, ICTs
RP4	Retire McMeekin	McMeekin and Urquhart 3 retirement, ICTs
RP5	Solar + Storage	Flexible Solar + Battery Storage, Combined Cycle, ICTs
RP6	Solar	Flexible Solar, ICTs
RP7	Solar PPA + Storage	Flexible Solar PPA + Battery Storage, ICTs
RP8	Retire Coal	Replace Wateree and Williams with Combined Cycle, Solar and Battery Storage, ICTs

Each portfolio represents a combination of existing, new and retiring resources identified by DESC as being able to meet system needs, with the primary factor for requiring new capacity additions being meeting winter base reserve margins. The eight portfolios are made up of DESC-defined combinations of six new supply-side resources, including company-owned solar and storage, solar power purchase agreements, and combined cycle and combustion turbine natural gas plants.[7]

The Company used these resource portfolios to meet the system needs assuming a base load forecast. Modifications from the base load forecast are used to represent higher and lower levels of DSM savings. The Company then modeled the annual production costs (using the PROSYM computer model) and capital costs (using a separate Excel-based model) for the eight portfolios under six scenarios. The six scenarios combined

[6] Table "Description of Resource Plans", DESC 2020 IRP at 40.
[7] See Table "Description of Potential Resources", DESC 2020 IRP at 39.

assumptions for three levels of natural gas costs, and two levels of costs for CO_2 emissions.

Q: Please describe the costs of the various portfolios in the 2020 DESC IRP.

A: DESC presents the 40-year levelized cost, expressed in net present value ("NPV") terms, for its eight resource plans under six scenarios comprised of three different natural gas price forecasts and two carbon costs of either $0 or $25 per ton of CO_2.[8] A medium DSM case was assumed for these comparisons.

Over a 40-year period the absolute difference in estimated present value costs of the portfolios ranged from $29 million to $54 million out of total costs ranging from $1.1 billion to $1.7 billion. On an annual basis the cost differences between portfolios range from $730,000 to $1.349 million. Dividing the annual difference in costs by 700,000 (the approximate number of DESC electric customer accounts) the estimated cost differences between portfolios under all six scenarios range from $1 to $2 per customer per year.[9]

Q: How should the Commission consider this cost comparison between plans?

A: A Commission should look to other factors to discern the most reasonable and prudent plan, such as the risk of upside fuel volatility that could cause rate shock or environmental regulatory issues that could greatly increase the cost of a high-emission scenario versus a lower one.[10]

Q: How do the portfolios presented by DESC in the 2020 IRP compare in light of these other factors?

[8] DESC 2020 IRP at 45.
[9] This represents the simple division of the estimated NPV costs by an approximate number of DESC customers. It does not represent a specific estimate of rate or bill impacts.
[10] As explained later in my testimony, due to flaws in the Company's assumptions and methods, I do not believe that the DESC IRP identifies the most reasonable and prudent plan in its 2020 IRP.

A: There are significant differences between the portfolios in terms of renewable energy growth and potential risks such as environmental compliance costs and fuel costs.

Looking at CO_2 emissions, for example, the DESC 2020 IRP provides CO_2 emission comparisons, by rank order, and by estimated 2030 annual emissions.[11] Across all scenarios with a medium DSM level assumed, RP8—which features the retirement of all coal generation by 2030—has the lowest emissions. RP1 and RP2, both of which feature additions of gas-fired power plants, have the highest emissions. The difference in emissions between the portfolios is significant. Figure 1 below illustrates annual CO_2 emissions for RP2 and RP8. [12]

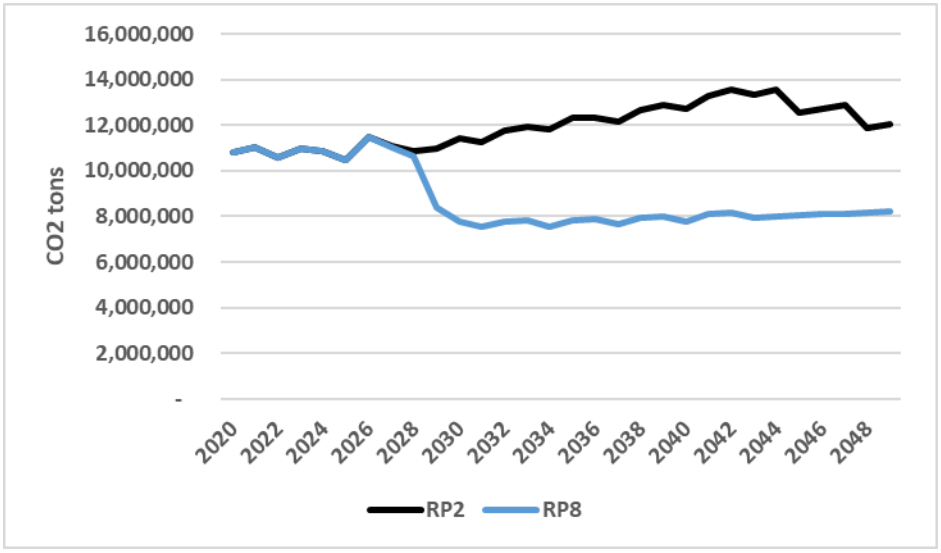

Figure 1. Annual CO2 Emissions – RP2 v. RP8

While for the first six years, the projected emissions are the same for both portfolios, RP8 results in substantially lower annual emissions thereafter, with expected emissions reductions ranging from 30 to 40% below 2020 levels. Figure 2 illustrates the

[11] DESC 2020 IRP at 47–48.
[12] **Exhibit DH-3** provides the workbook I used for this and the additional review and calculations I conducted in review of the DESC 2020 IRP.

cumulative difference in CO2 emissions between the two portfolios. For both portfolios, cumulative emissions continue to rise through 2049.

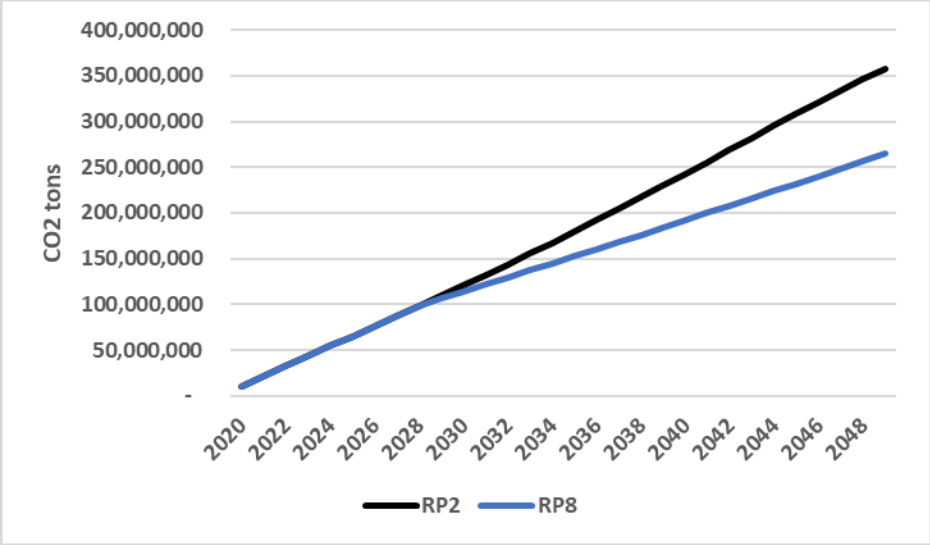

Figure 2. Cumulative CO2 Emissions – RP2 v. RP8

Through 2049, RP8 reduces CO_2 emissions by more than 93.4 million tons of CO_2, or more than 26% in comparison to RP2. These cumulative results are summarized in Table 2 below.

Table 2. Absolute and Percent Differences for CO_2 Emissions between RP2 and RP8

	Cumulative CO2 (tons)	
Resource Plan	**2020 - 2030**	**2020 - 2049**
RP2 Med	120,560,234	358,057,249
RP8 Med	113,967,147	264,619,387
Absolute Difference	6,593,087	93,437,862
Percent Difference	-5.47%	-26.10%

Q: How do the higher gas and carbon cost sensitivities affect the cost of the different portfolios?

A: DESC's analysis showed that RP7 and RP8 were the two lowest cost plans under all scenarios with a $25/ton cost of carbon, and RP7 was least cost in the high gas scenario.[13]

Q: Are there differences in the amount of renewable generation between portfolios?

A: Yes. Compared with RP1 through RP4, which all have the same level of renewable generation, RP5 through RP8 have higher levels of renewable generation, particularly after 2030.[14] As illustrated in Table 3, by 2049, RP8 is expected to result in 54,693 GWh more renewable generation than RP2, an increase of more than 90%.

Table 3. Absolute and Percent Differences in Renewable Generation between RP2 and RP8.

Renewable Generation GWh				
	2020-2029	2030-2039	2040-2049	Total
RP2	19,912	20,338	20,339	60,589
RP8	20,429	35,343	59,510	115,282
Absolute Difference	517	15,005	39,171	54,693
Percent Difference	2.6%	73.8%	192.6%	90.3%

Figure 3 below illustrates this difference, with RP8 having close to twice the total renewable generation than RP2.

[13] DESC 2020 IRP at 45.
[14] *Id*. at 49.

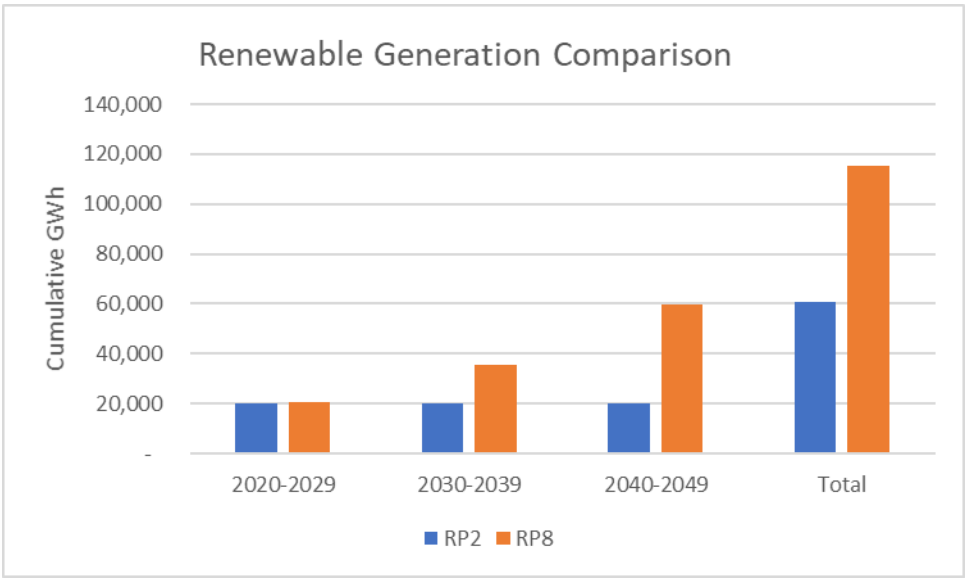

Figure 3. Renewable Generation – RP2 v. RP8.

Q: Are there risks associated with any of the portfolios that should also be considered when evaluating the portfolios against each other?

A: Yes. Portfolios RP3 and RP8, each of which include early coal plant retirements, reduce risks associated with environmental compliance and potential risks associated with cost of carbon regulation. Early retirement of the Wateree and Williams plants avoid significant capital costs: at Wateree for flue-gas desulfurization ("FGD") and wastewater treatment and at Williams station for bottom ash transport water treatment and FGD water treatment.[15] The review of the DESC 2020 IRP conducted by Charles River Associates states that RP8 avoids $900 million in capital expenditures required to retrofit existing coal units with environmental upgrades.[16] The portfolios with coal plant retirement reduce or eliminate these risks.

[15] DESC Response to S.C. Coastal Conservation League and Southern Alliance for Clean Energy's Request No. 2-31, Docket No. 2019-226-E.
[16] Independent Review of the 2020 DESC IRP, Charles River Associates, p.92.

The portfolios with higher renewable generation—RP5, RP6, RP7 and RP8—further reduce risks associated with natural gas fuel prices, reduce the state-wide expenditure on fossil fuel imports, and rely on more modular capacity expansions and investment decisions.

Q: What conclusions do you reach based on this information?

A: The EFA directs that an IRP fairly evaluate options for meeting future system needs under a variety of uncertainties and with a range of portfolio options. South Carolina's ratepayers stand to benefit from reduced emissions of greenhouse gases and other pollutants from coal plant operations, and a system that reduces import of out of state fossil fuels.

In the DESC 2020 IRP Executive Summary, the Company mentions trends toward clean energy and an openness to future system investments that will capture such benefits.[17] However, RP2, which the Company identifies as its base case[18] does little to reflect these opportunities or changes in broader energy markets. It is a "business-as-usual" plan.

Yet despite its flaws, the DESC 2020 IRP itself illustrates that under most scenarios, a lower carbon, higher DSM and renewable portfolio with coal retirements is a least cost, low-risk plan. Under half of the scenarios modeled, RP8 has lower total costs than RP2. The scenarios represent potential foreseeable future conditions that the Commission should consider in a balanced comparison of the resource plans.

[17] DESC 2020 IRP at 1.
[18] *Id*. at 46.

Even under the scenarios without a carbon price, shifting to higher renewable and lower carbon portfolios is estimated to add costs of only $1 to $2 per household per year. ***Meanwhile, the low carbon plan analyzed by the Company reduce CO_2 emissions by more than 26% and almost doubles the amount of generation coming from in state renewable resources with zero fuel costs.***

Choosing a plan with greater CO_2 reductions better hedges against future environmental regulations and carbon pricing. These benefits justify selection of a resource portfolio with higher levels of clean energy resources and retirement of uneconomic coal plants, which reduces the risks associated with power plant construction, fuel costs and compliance with other environmental regulations.

III. IRP LOAD FORECAST, ANALYSIS AND MODELING OF DEMAND-SIDE, SOLAR, AND BATTERY STORAGE RESOURCES

Q: Are there elements of the DESC IRP modeling and analyses that you found to be deficient?

A: Yes. In several instances, DESC's analysis is flawed and/or based on unreasonable assumptions relating to the costs and availability of demand-side, solar, and storage resources. The IRP also discusses a high and low load forecasts, but it only uses a base load forecast in the study.

Under the EFA, IRPs must include "several resource portfolios developed *with the purpose of fairly evaluating the range of demand-side, supply-side, storage, and other technologies and services* available to meet the utility's service obligations." These portfolios and evaluations "*must include* an evaluation of low, medium, and high cases

for the adoption of renewable energy and cogeneration, energy efficiency, and demand response measures, including consideration of the following: (i) customer energy efficiency and demand response programs; (ii) facility retirement assumptions; and (iii) sensitivity analyses related to fuel costs, environmental regulations, and other uncertainties or risks." S.C. Code Ann. 58-37-40(B)(1)(e) (emphasis added).

Taken together, the effect of these flawed analyses leads me to conclude that DESC's 2020 IRP analysis does not "fairly evaluate" these resources. I will discuss my critiques of DESC's evaluation of each resource type in turn below.

A. Load Forecasts

Q: Does the DESC 2020 IRP include a sensitivity analysis based on alternative load forecasts?

A: It appears that the Company conducted a sensitivity analysis, but did not use it in its portfolio modeling. In Part I of the 2020 IRP, the Company states that it "analyzed the sensitivity of its sales growth rate as required by § 58-37-40(B)(1)(a) under Act No. 62" and discusses its analysis of low and high growth cases.[19] However, in its overview of the Resource Plan Analysis, the Company states that "[t]he Company's base forecast of energy and demands was used in the study."[20]

Even though DESC developed a low and high load forecast, DESC did not model any of its eight resource plans with the low and high load forecast. The sensitivities DESC chose to model included the three different DSM cases, three fuel price scenarios, and two CO2 price scenarios. While DESC did evaluate the eight resource plans across

[19] DESC 2020 IRP at 10.
[20] *Id*. at 37.

the three DSM cases, there was no modeling conducted with the assumption of either the low and high load forecast paired with varying levels of DSM cases or the fuel price and CO_2 scenarios. A DSM case is not the same as a high or low load growth forecast. While load growth may be offset by DSM savings, the underlying levels of growth are driven primarily by economic, demographic and weather conditions.

To be comprehensive and consistent with the EFA, the IRP modeling should include sensitivities for a low load forecast. Furthermore, based on historic data from 2020-2019, the low load growth forecast should be lower than what the Company presented in Part I of the Plan. Table 4 and Figure 3, below, show that the Company's low forecast for summer and winter peak load is higher than the historical trend.

Table 4. Comparison of Historical and Forecasted Average Annual Peak Demand Growth

	Avg Annual Growth	
	Winter	**Summer**
Historical	-0.77%	-0.02%
Forecast Base Net Firm	0.70%	0.71%
Forecast Low Net Firm	0.48%	0.49%

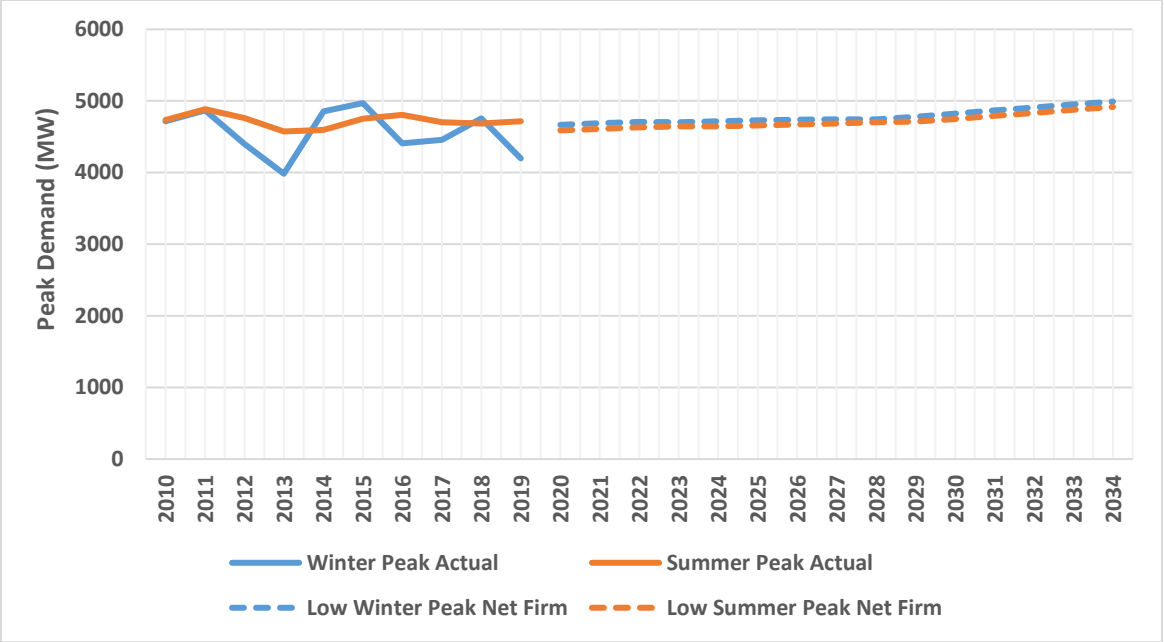

Figure 4. Historical Peak Demand and Low Forecast Net Firm Peak Demand[21]

B. DESC's Analysis of Demand-Side Resources

Q: What issues related to DESC's analysis of demand-side resources would you like to address?

A: DESC's analysis of DSM resources was deficient in several respects. As noted above, the EFA requires the Company to investigate and fairly evaluate a range of demand side options, and such an evaluation "must include an evaluation of low, medium, and high cases for the adoption of energy efficiency, and demand response measures." S.C. Code Ann. 58-37-40(B)(1)(e). DESC's 2020 IRP, however, does not fairly evaluate a "high case" for DSM. Rather, DESC presents, but dismisses out of

[21] Historical peak demand is based on DESC's Response to Office of Regulatory Staff Request No 5-5, Docket No. 2019-226-E. Forecasted net firm peak demand is from DESC's Response to Office of Regulatory Staff Request 1-1(b), Docket No. 2019-226-E.

hand, its own "High DSM" case, a level of DSM savings equal to 1% of annual retail sales. The Company states on page 42 of the IRP:

> "It should be noted that the High DSM case was not supported in the 2019 Potential Study and is based only on estimates, likely not achievable and cost effectiveness is unknown."

A fundamental question this statement raises is why the Market Potential Study conducted by ICF—which DESC used to inform the DSM inputs in its 2020 IRP—***did not*** include analysis of a DSM portfolio with higher levels of savings. The results of the Market Potential Study indicate the "expanded" portfolio, which is modeled as the medium level of DSM in the IRP, is clearly cost effective for each customer class and program.

And the fact that the Market Potential Study did not characterize a high DSM case does not mean that the DESC IRP need not include a fair evaluation of a high DSM case. Simply dismissing a 1% DSM savings case as unachievable, as the Company has done in the IRP, is not consistent with the requirements of the EFA and the Commission should direct DESC to correct this error.

Q: What is the basis for your assertion that 1% DSM savings are achievable and DESC should not have dismissed the High DSM case?

A: First, other studies in the region have identified greater potential than DESC's study. Figure 5, from page 39 of the Market Potential Study, illustrates that six of the eight comparison cases from recent studies in the Southern region indicate higher savings

potential than DESCs expanded scenario.[22]

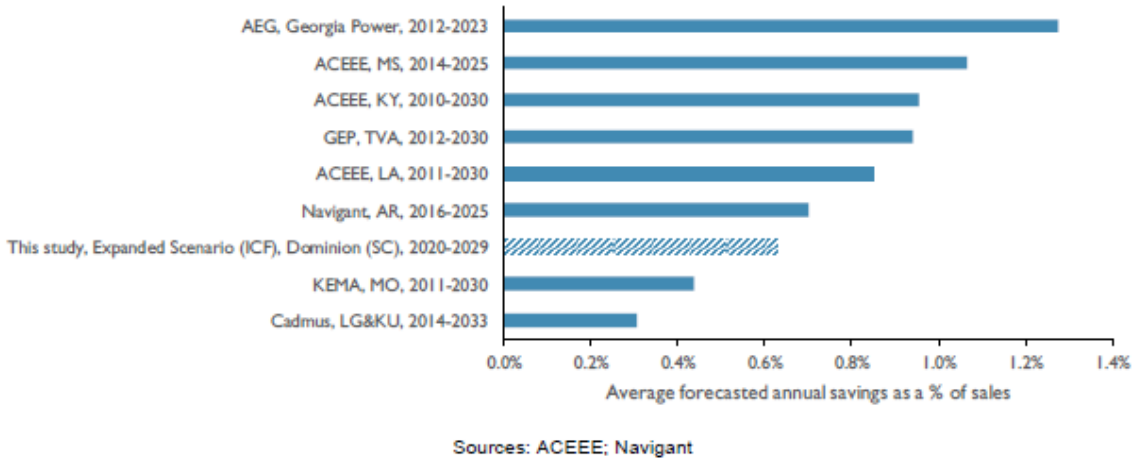

Figure 5. Regional Benchmarking DSM Potential Studies.

For additional comparisons, The American Council for an Energy-Efficient Economy ("ACEEE") 2020 Utility Energy Efficiency Scorecard provides a comparison of 52 electric utilities in the United States. Table 5 highlights eighteen public and investor owned electric utilities that achieved greater than 1.25% savings as a percentage of retail sales in 2018.

[22] The calculation of the average savings as a percent of sales for DESC excludes the forecasted sales from opt-out customers, so DESC's savings as a percent of total sales would therefore be lower than represented in the graphic.

Table 5. Utilities Achieving Annual Incremental DSM Savings Greater Than 1.25% of Sales.[23]

Utility	State	Savings as a % of Sales
Massachusetts Electric	MA	3.73%
Eversource MA	MA	3.15%
San Diego Gas & Electric	CA	2.35%
Commonwealth Edison	IL	2.08%
Salt River Project	AZ	2.05%
Baltimore Gas & Electric	MD	1.96%
Northern States Power	MN	1.73%
Los Angeles Department of Water & Power	CA	1.63%
Pacific Gas & Electric	CA	1.61%
Southern California Edison	CA	1.55%
Consumers Energy	MI	1.55%
Eversource CT	CT	1.54%
DTE Electric	MI	1.50%
Public Service Co of Colorado	CO	1.45%
Portland General Electric	OR	1.45%
Long Island Power Authority	NY	1.41%
Duke Energy Ohio	OH	1.32%
Mid American Energy	IA	1.27%

Q: What level of cumulative savings from DSM does the IRP project over five years, and do you agree with this value?

A: The DESC 2020 IRP states that the medium DSM case is based on the expanded program portfolio from the market potential study, which is projected to yield cumulative annual portfolio savings equal to 3.5% of the previous year's sales by 2025.[24] Therefore, I would expect the cumulative DSM savings by 2025 as a percent of sales requirements

[23] Relf et al., American Council for an Energy-Efficient Economy, *2020 Utility Energy Efficiency Scorecard*. p. 26 Table 8, available at https://www.aceee.org/sites/default/files/pdfs/u2004%20rev_0.pdf

[24] 2019 Market Potential Study, p. 25 Table 12. Using both incremental and cumulative savings as a percent of sales requirements is a common metric allowing savings to be compared across large and small utilities.

from the IRP's medium DSM case to be consistent with the market potential study's estimate of 3.5%.

To check this, I calculated the cumulative annual savings estimates as a percent of sales for each of the DSM cases included in the Company's workbook.[25] Figure 6 illustrates these results. For the IRP's medium DSM case, my calculations estimate the cumulative annual savings in 2025 are 2.45% of sales requirements.

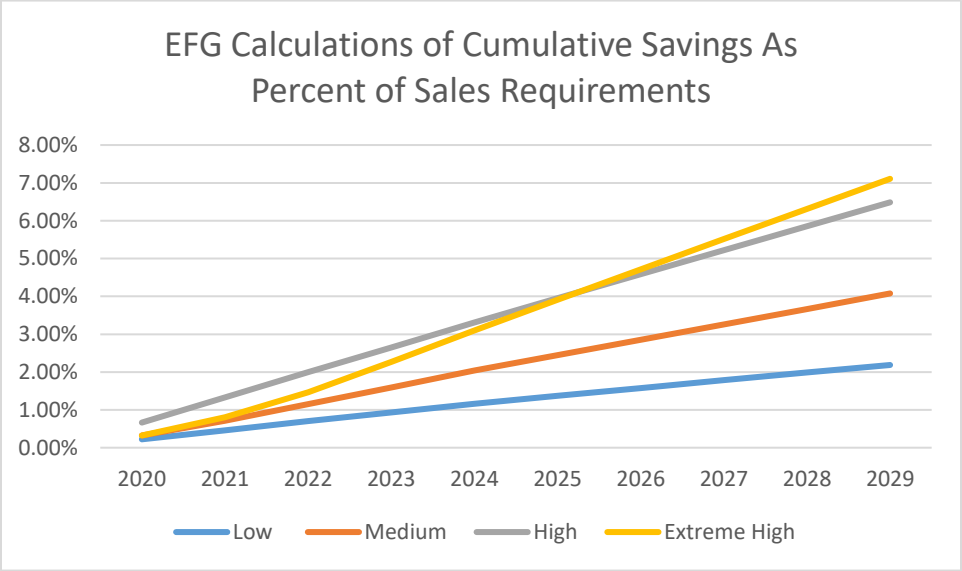

Figure 6. Accumulated Savings as Percent of Sales.

The most likely explanation of why the medium case savings as percent of sales that I calculated (2.45%) is lower than the estimate from the market potential study (3.5%) is that the market potential study estimate excluded sales to non-residential customers who have opted out of DSM program services. Sales to opt-out customers should not be excluded from the denominator when calculating DSM savings as a percent of sales. The lower value that I estimated for the DSM medium DSM case (2.45%)

[25] DESC Response to SACE CCL DR 2-13, workbook "DSM Costs (012720)."

provides a more accurate value for comparing the level of DSM savings projected in the IRP to other jurisdictions.

The contrast between the 3.5% cumulative 5-year impact estimated in the Market Potential Study, and the lower estimates from the Company's workbooks underscores the point that the DESC 202 IRP appears to consistently under-represent the potential for demand-side resources in the IRP. As DESC's consultant ICF recognized in the market potential study, demand response and energy efficiency are cost-effective resources providing significant benefits that lower overall system costs and save customers money.

Q: Do you have any other concerns about the way DESC characterized DSM resources in the IRP?

A: Yes. It also appears that, in several instances, DESC modeled the costs of DSM resources but did not model any associated energy savings or peak impacts. As a result of this lopsided analysis, DESC's 2020 IRP does not accurately reflect the value of DSM resources to ratepayers and the Company's system.

In response to a discovery request, DESC provided a workbook that included a summary of the scenarios, 40 year DSM cost and savings projections and scenario definitions.[26] Both this workbook sheet and DESC's modeling files appear to not include any DSM/EE savings from 2020 and 2021, but the costs do appear to be counted. In addition, there appeared to be discrepancies in DESC's cumulative savings calculations; for example, the medium scenario cumulative savings sum to 430 GWh by 2025, while the summary sheet indicates five-year savings for the medium DSM case as 498 GWh.

[26] DESC Response to SACE CCL Data Request 2-13.

During the preparation of my testimony I was unable to reconcile this discrepancy, but it appears that for all the model runs and DSM cases, DESC assumed no peak reduction or energy savings from EE for 2020 and 2021, and therefore understated portfolio savings. For example, the medium DSM case projects cumulative annual savings of 327 GWH by 2024 rather than the 499 GWH cited in the market potential study.[27] While DESC seemingly did not include all savings from the medium DSM scenario, DESC did include the costs of EE and DR for 2020 and 2021 in the NPV calculation. ***These discrepancies are a concern and indicate that across the IRP the beneficial impacts of each level of DSM examined are under-reported***.

Q: Did DESC reasonably characterize DSM resources after 2029?

A: No. DESC held DSM savings constant for 30 years after 2029. Essentially, DESC's analysis assumes that after 2029, the Company can do no better than replace historic DSM savings.

Given that the average measure lifetime for DSM measures is 10 years, it is true that after 10 years savings from new measures will replace savings from measures that have "retired." This is particularly true when a portfolio has a sustained level of relatively high savings, such as those presented in Table 5 above. However, when savings as a percent of sales are at the low levels represented in the DESC 2020 IRP, this is an unduly conservative assumption that is not supported by industry experience or any analysis that would support a departure from that experience. This assumption skewed the analysis in a way that unfairly disadvantaged DSM resources.

[27] 2019 Market Potential Study, ICF, p. 25 Figure 11.

Q: Given the concerns you have identified with the analysis of DSM as a resource, what are your observations about the comparative results of DSM levels in the plan?

A: My comments above suggest that DSM savings may well be understated and costs over-stated in all portfolios and scenarios. Even with these deficiencies, however, ***for most of the portfolios, the higher level of DSM reduces total NPV costs in comparison to the medium level of DSM***. As the DESC 2020 IRP illustrates, for six of the eight portfolios (RP1, RP2, RP3, RP5, RP6, and RP8), the NPV levelized costs for High DSM are lower than they are for Medium DSM.[28] DESC dismisses these results by claiming the high level of DSM is for illustrative purposes only.

I do not accept DESC's contention that the High DSM case savings results are for illustrative purposes only. The EFA states that the IRP "must include" an analysis of high levels of DSM. S.C. Code Ann. 58-37-40(B)(1)(e). The DESC plan does not do this by simply dismissing the High DSM case as "not being supported by the market potential study, as being based on estimates, not likely achievable and cost effectiveness is unknown."[29] This is a serious deficiency that the Commission should order the Company to remedy in a corrected IRP.

C. <u>The 2020 DESC IRP's Analysis of Demand Response and Flexible Load Resources</u>

Q: What are "flexible load resources"?

[28] DESC 2020 IRP at 43.
[29] *Id*. at 42.

A: Flexible load resources include traditional demand response, load shifting, coordinated loads, and storage. Traditional demand response can include device-based switching, interruptible loads, stand-by generation, and rate-based strategies. Some demand response may increase energy consumption at certain times (as is the case for batteries), but they can be used to improve load factor and be used to reduce peaks.

Q. Has DESC analyzed the potential for flexible load resources and recognized their value in other contexts?

A. Yes. For example, the 2019 Market Potential Study identifies and discusses a range of cost-effective flexible load options for DESC, noting that an expanded portfolio, including direct load control for residential and commercial customers, is highly cost effective with a total resource cost test benefit cost ratio estimated to be 2.0.[30] Figure 8 illustrates the anticipated addition of direct load control to the reference scenario (existing DR), which consists of interruptible loads and standby generation.

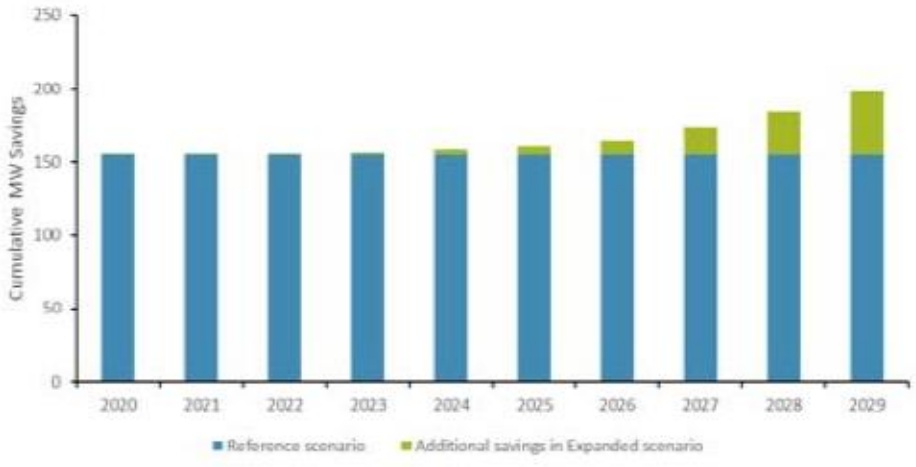

Figure 7. Winter DR Savings Forecast, Market Potential Study.

[30] 2019 Market Potential Study, ICF, p. 51.

The Market Potential Study elaborates on additional cost-effective time of use and critical peak pricing rate designs, which add 106 MW of winter peak DR resources by 2029, as illustrated in Figure 9.[31] The Market Potential Study notes that with the anticipated deployment of Advanced Metering Infrastructure ("AMI"), these additional rate-based measures should not be limited by the lack of AMI.

Figure 8. Enhanced DR Peak Savings.

Q. Did DESC fairly evaluate demand response resources in the DESC 2020 IRP?

A: No. It appears the cost-effective DR savings potential estimated in the Market Potential Study has not been incorporated into the portfolio analysis used to develop the 2020 IRP. On page 10, the DESC 2020 IRP lists 2029 winter peak DR as 276.4 MW. This is lower than the 304 MW peak referenced by the Market Potential Study in Figure 7 above. Further, Company workpapers identify 198 MW winter peak DR savings for the

[31] *Id*. at Appendix A.

medium DSM case.[32] In either case, the winter peak DR savings that were modeled for the purpose of comparing resource portfolios are lower than the DR potential identified as cost effective in the Market Potential Study. Since winter peak reserve margin is a key factor in determining the need for new resources, accurately characterizing and modeling cost-effective winter peak DR savings should be a priority for the IRP.

The impact of the way that DESC has characterized DR in the DESC 2020 IRP is that the portfolios, and the comparison between the portfolios, do not accurately reflect the potential for cost-effective DR resources to reduce the need for costly new supply resources. DESC's analysis does not represent the fair evaluation required by the EFA and should be remedied.

D. Characterization of Solar and Battery Resources

Q: Did the Company fairly evaluate solar and battery technologies?

A: No. The cost characterizations for solar and batteries are likely to be too high based on several factors. First, solar, and batteries charged by solar, are eligible for Federal Investment Tax Credits (ITC). DESC modeled solar paired with storage resources in RP5, RP7 and RP8. However, the capital costs modeled by DESC do not reflect any level of ITC applied to the storage resources. DESC also did not model a 10% ITC for any solar resource added after 2023.

While the tax credits are scheduled to decrease, it is reasonable to anticipate that a minimum of a 10% investment tax credit will continue to be available during the plan horizon. Currently, the ITC is scheduled to decline to 10% in 2022 for utility and commercial scale solar installations and remain at that level thereafter. Recent proposed

[32] DSM Costs (01272) provided in response to SACE DR 2-13.

legislation includes a possible 5-year extension to the ITC. This would maintain a 30% credit through 2025, and then step down to 10% by 2028 for commercial and utility scale installations.[33]

DESC also applied inconsistent assumptions to Company-owned solar and solar+storage resources and those owned by independent power producers. In its report, CRA said "DESC evaluated solar and solar plus storage resources, which are both eligible to receive an ITC. However, for owned resources built in 2026, DESC assumed no capital cost discount associated with the ITC. For PPA resources, on the other hand, DESC incorporated the ITC into the PPA cost through its levelized cost calculation."[34] The cost estimates for both the Company owned and PPA resources should accurately reflect the available Federal credits and the ITC. In addition, maintaining a 10% ITC credit for commercial and utility scale solar after 2022 is a reasonable assumption for the analysis.

Q: Did the Company use and document a reasonable range of cost estimates for battery storage?

A: No. DESC only used a single cost estimate, and compared to an industry standard reference, the National Renewble Energy Laboratory Annual Technology Baseline ("NREL ATB"),[35] it appears to be high. Battery cost projections as modeled in the plan and from the NREL ATB are represented in Figure 10.

[33] Solar Electric Industries Association, "*Congressional Leaders Call for Solar Specific Solutions in Economic Recovery Plan*", June 25, 2020**.** www.seia.org/news.
[34] Exhibit EHB-2, p.61.
[35] NREL (National Renewable Energy Laboratory), *2019 Annual Technology Baseline*, available at https://atb.nrel.gov/electricity/2019.

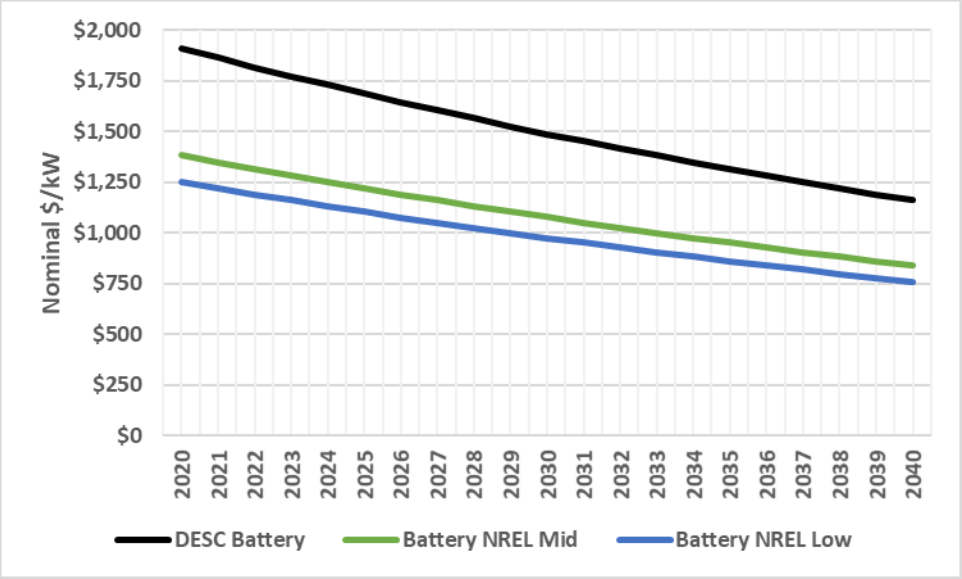

Figure 9. Projected Battery Storage Costs.

The figure illustrates that the cost assumptions DESC used in the 2020 IRP are consistently significantly higher than the Medium and Low NREL projections through 2029. Batteries, both those owned by the utility or customer sited, hold promise as options for addressing the winter peak constraints which DESC identifies as the key driving factor for resource additions in the plan. To meet the explicit directives in the EFA, the plan should include low, medium and high cost projections for batteries, either under individual scenarios or in sensitivity analyses. The comparison presented in Figure 10 suggests the battery costs as modeled in the plan represent high cost assumptions. The implications of this for the plan are that the potential for battery resources to contribute to least cost portfolios are understated.

Q: Did you identify any other flaws in the Company's evaluation of solar and battery technologies?

A: Yes. DESC modeled solar+storage resources under RP5, RP7 and RP8. The expansion plan workbooks[36] show that DESC modeled the solar+storage resources with different assumptions about the size of the solar resource. RP5 and RP7 each include a solar project sized at 400 MW paired with a battery sized at 100 MW. However, these size assumptions change when solar+storage projects are modeled in RP8, as these solar projects are sized at 100 MW with a battery sized at 100 MW.

Furthermore, the expansion plan workbooks for RP5 and RP7 indicate that the 400 MW of solar added do not provide any contribution to the summer capacity as the capacity is set to 0 for the solar resource. Since the solar project is modeled at 400 MW, with a capacity contribution of 8.8%, the capacity contribution for the solar should be 35.2 MW. I would also expect the summer and winter peak contributions of solar paired with batteries to be higher than the capacity contribution from solar without storage, but this does not appear to be the case in the plan.

Q: Do you have any observations on the Company's characterization of other supply options?

A: Yes. DESC also used unreasonably low-cost estimates for gas-fired combustion turbines (referred to in the IRP as "Internal Combustion Turbines" or "ICTs"). The figure below shows the comparison between DESC's capital cost assumptions for the ICT Frame, derived from "Dominion Energy Services – Generation Construction Financial Management & Controls,"[37] and the NREL capital cost assumptions for ICTs. DESC

[36] Expansion plan files for resource plans provided in DESC Response to Office of Regulatory Staff No. 2-33 (a),Docket No. 2019-226-E.
[37] DESC 2020 IRP at 39 ("Description of Available Resources" table).

modeled the ICT capital cost at $469/kW.[38] In comparison, the NREL capital cost estimate for an ICT is $932/kW.

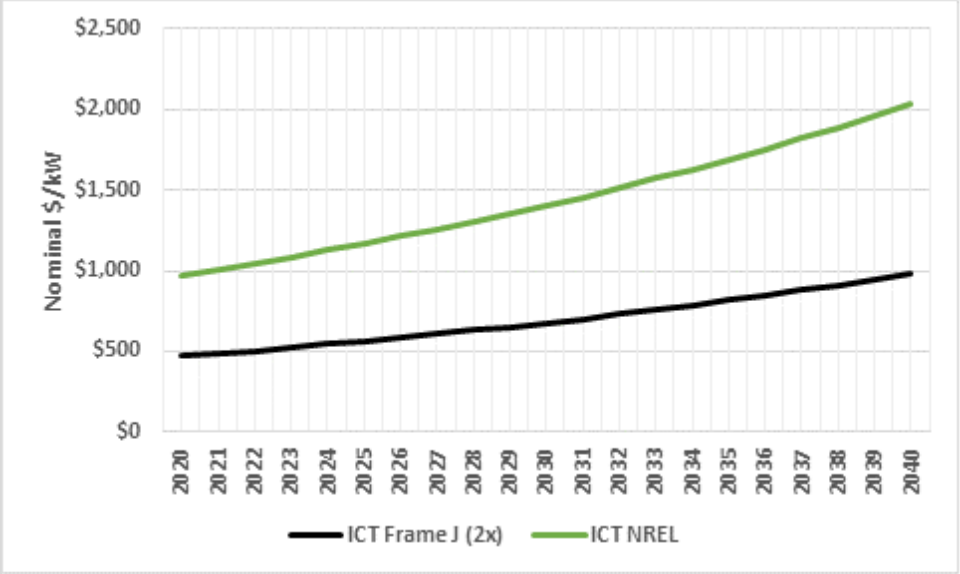

Figure 10. Comparison DESC ICT Capital Cost with NREL.[39]

By using consistently lower cost projections for gas-fired generation options and higher cost projections for batteries and solar technologies which can both provide power at peak times, DESC has disadvantaged solar and batteries, and as a result its IRP does not identify the optimal resource mix. This is a patently *un*fair evaluation and should be remedied.

E. Intervenor-Provided Resource Plans and Scenarios

Q: Does the DESC 2020 IRP include consideration of Intervenor-provided portfolios?

[38] DESC 2020 IRP at 39 ("Description of Available Resources" table).
[39] The NREL Mid and NREL Low assume the 2020 capital cost value from the ATB with DESC's escalation assumption of -2.46%.

A: Yes. In an appendix to the 2020 IRP, DESC describes its analysis of five resource plans submitted by the Solar Business Alliance (labeled as SBA1 through SBA5). These plans ("Intervenor Resource Plans") include plans with higher levels of DSM savings, coal retirements, and the addition of solar, and battery resources beyond levels contained in the Company's portfolios.

Q: Does the 2020 IRP Estimate the 40 Year levelized NPV for the Intervenor Resource Plans, and if so, how do these compare to the results for the Company-defined portfolios?

A: Yes, Table 6 provides the estimated NPV costs for the Intervenor Resource Plans.[40]

Table 6. Cost Estimates for Intervenor Resource Plans.

40 Year Levelized NPV of the Intervenor Resource Plans

Resource Plan ID	$0/ton CO_2, Low Gas	$0/ton CO_2, Base Gas	$0/ton CO_2, High Gas	$25/ton CO_2, Low Gas	$25/ton CO_2, Base Gas	$25/ton CO_2, High Gas
SBA 1	$1,181,917	$1,259,710	$1,426,579	$1,396,358	$1,475,537	$1,669,170
SBA 2	$1,142,465	$1,211,484	$1,368,241	$1,333,510	$1,406,644	$1,583,127
SBA 3	$1,179,934	$1,236,930	$1,382,570	$1,329,021	$1,389,003	$1,544,806
SBA 4	$1,192,393	$1,261,454	$1,421,922	$1,401,112	$1,472,960	$1,651,763
SBA 5	$1,157,146	$1,233,152	$1,400,031	$1,372,049	$1,451,312	$1,639,753

Table 7 presents the same information for the DESC portfolios evaluated in the IRP.

[40] DESC 2020 IRP at A-4.

Table 7. Cost Estimates for DESC Resource Plans.

Resource Plan Levelized NPV for Medium DSM ($000)

Resource Plan ID	Resource Plan Name	$0/ton CO_2, Low Gas	$0/ton CO_2, Base Gas	$0/ton CO_2, High Gas	$25/ton CO_2, Low Gas	$25/ton CO_2, Base Gas	$25/ton CO_2, High Gas
RP1	CC	$1,166,528	$1,249,160	$1,427,424	$1,385,375	$1,469,436	$1,668,590
RP2	ICT	$1,145,532	$1,231,667	$1,416,354	$1,370,853	$1,461,736	$1,665,599
RP3	Retire Wateree	$1,165,235	$1,251,077	$1,444,505	$1,372,378	$1,460,334	$1,666,688
RP4	Retire McMeekin	$1,154,191	$1,239,802	$1,425,558	$1,380,307	$1,470,231	$1,675,337
RP5	Solar + Storage	$1,186,034	$1,266,727	$1,435,093	$1,394,516	$1,475,915	$1,669,182
RP6	Solar	$1,163,394	$1,246,165	$1,423,590	$1,378,987	$1,465,797	$1,665,995
RP7	Solar PPA + Storage	$1,154,889	$1,236,518	$1,413,532	$1,370,024	$1,455,686	$1,654,813
RP8	Retire Coal	$1,183,714	$1,267,624	$1,467,499	$1,356,160	$1,438,706	$1,646,153

Comparing the green highlighted cells in each column of Tables 6 and 7 shows that ***for every scenario***, ***the least cost portfolio from the Intervenor Plans is less costly than the least cost portfolio in every scenario from the DESC plan***. The difference ranges from $3 million ($0 CO2/Low Gas) to more than $100 million ($25 CO2/High Gas) in 40-year NPV costs.

Q: How does the Company address the Intervenor Resource Plans in the IRP?

A: The Company dismisses the intervenor plans summarily, stating that "no direct comparisons to DESC's resource plans were possible due to the low resource cost information provided by the third parties, which in DESC's view, results in a low portfolio cost bias and prevents a practical comparison."[41]

Q: Do you agree with these statements?

[41] DESC 2020 IRP at A-1.

A: No. I disagree with the Company's position. On the contrary, it would be not only possible, but entirely practical and prudent, to compare the Intervenor Plans to DESC's resource plans based on the documented inputs and proposed portfolios.

The Intervenor Resource Plans based their cost estimates on the National Renewable Energy Laboratory's 2019 Annual Technology Baseline ("ATB").[42] While the Company may prefer to use the medium case projections from the ATB, the use of well documented low-cost technology forecasts is appropriate. This holds particularly for solar and battery technologies, where recent actual prices have consistently been lower than many projections.

Q: Please comment on the Company's dismissal of the Intervenor DSM assumptions.

A: The Company asserts that "DSM levels above those provided within the 2019 Potential Study are not likely to be achievable and cost-effectiveness is unknown."[43] The Company also characterizes the 1.25% DSM savings contained in the intervenor portfolios as not likely to be attainable, nor cost-effective. However, as explained earlier in my testimony, the DESC 2020 IRP bases its DSM cases primarily on the Company's Market Potential Study, which limited the "expanded" DSM portfolio to the medium level of DSM. Referring to Figure 5 and Table 5 in my Testimony above, which provide benchmarking to savings attained by other regional and leading DSM initiatives the Intervenor Resource Plan's high DSM case of 1.25% savings is entirely reasonable.

[42] National Renewable Energy Laboratory, Annual Technology Baseline (ATB), 2019. https://atb.nrel.gov/
[43] DESC 2020 IRP at A-3.

Q: Do you believe that DESC's summary dismissal of the Intervenor Plans was reasonable?

A: No, I do not. The EFA explicitly requires that the IRP consider high, medium and low cases for renewable adoption, energy efficiency and other resources. As discussed previously in my testimony, DESC employed its own biased assumptions to suppress the cost of new gas capacity, inflate the cost of renewables and storage, and depress the potential for DSM and EE. The Intervenor Plans presented well-documented and defensible assumptions that deserved a fair evaluation by the Company. Instead of using the Intervenor Plans to inform its portfolio analysis, however, the Company simply brushed them aside. It was inappropriate for the Company to relegate the analysis of the Intervenor portfolios to an Appendix without addressing the potential benefits of these alternative portfolios more fully in the plan.

VI. CONCLUSIONS AND RECOMMENDATIONS

Q: Please summarize your conclusions.

A: In conclusion, based on my review of the DESC 2020 IRP:

- DESC's cost comparison results demonstrate that portfolios with higher levels of clean energy resources and lower emissions are either lower cost, or close in cost to plans with higher emissions and exposure to fuel and environmental compliance cost risks.
- The characterization of DSM resources in the DESC 2020 IRP contains flaws that apply across all portfolios and scenarios analyzed. The 2020 IRP unreasonably understates the value of DSM resources while overstating their

costs, and thus fails to "fairly evaluate" DSM resources as required by the EFA.[44]

- The portfolios modeled in the 2020 IRP do not fully reflect DR resources that were identified as cost effective in the Market Potential Study.[45] As such, the 2020 IRP unreasonably understates the ability of DR to help meet future system needs and is further evidence that DESC in its IRP has not fairly evaluated the range of demand-side resources available to meet its needs.
- The cost projections for solar and battery technologies in the DESC 2020 IRP analysis are high in comparison to industry references and therefore the portfolios may understate the ability of batteries and solar to cost effectively contribute to meeting future system needs.
- DESC did not compare the Intervenor Provided Resource Plans and Scenarios against its eight resource plans and did not provide justification for why such a comparison was impossible or why, in its view, the intervenor inputs were unreasonable. For every scenario, the intervenor's least cost resource plan is less costly than the least cost portfolio in the Company's Plan for the same scenario. I find the Company's dismissal of the intervenor portfolios to be unreasonable.

Q: In light of these conclusions, what are your recommendations to the Commission?

[44] S.C. Code Ann. § 58-37-40.
[45] Dominion Energy South Carolina: 2020–2029 Achievable DSM Potential and PY10–PY14 Program Plan Final Report, ICF International, June 2019.

A: Given these findings, I respectfully recommend the Commission reject the DESC 2020 IRP as filed and require that DESC correct the flaws identified in my testimony, revise its IRP in accordance with the requirements of the EFA and best industry practices, and submit a revised IRP within sixty days of a final order. At a minimum, as discussed in my testimony, these corrections should include higher DSM and DR savings, sensitivity analysis for a low load growth forecast, and cost adjustments and sensitivities for solar, battery storage and natural gas generation technologies.

My recommendations will ensure that the potential and benefits for these resources is accurately assessed so that South Carolina's ratepayers do not miss out on the opportunity to pursue low cost, clean electric generation portfolios that will benefit the economy, environment, and ratepayers for decades to come.

Q: Does this conclude your testimony?

A: Yes, it does.